December 2020

A citation analysis of chemistry publications by faculty members and research scholars at University of Mysore and Karnatak University

Kodandarama .
PES College of Engineering, Mandya, ramsripa@gmail.com

Chandrashekara M
Professor, Department of Library and Information Science, University of Mysore, Manasagangotri, Mysuru

A citation analysis of chemistry publications by faculty members and research scholars at University of Mysore and Karnatak University

Abstract

Purpose-The study aims to analyse the resources used in the citations of 1355 research publications of University of Mysore and Karnatak University in the field of chemistry and prepares the core journal list and prolific authors. For any research and academic institutional libraries, books and journals are considered as key resources. As the resources are more and diverse, collection building is a tough task for librarians. Citation analysis is one of the best methods to list the most used resources by the users. Hence, the paper highlights the extent of use of different sources in the research publications of chemistry.

Methodology-References of Chemistry research publications covered by Web of Science during 2009-2018 were the main data source for the study. Compiled references were recorded in the Ms Excel sheet for the analysis of bibliographic form, authorship pattern, country-wise citation and ranking of journals, publishers and authors. Ranking list was prepared on the basis of highest citations and place of journal publication was collected from the Scimago Journal Rank.

Findings- Study witnesses the use of various information sources in research publications. Source wise distribution of citations shows the highest journal literature use in the study which accounts for 89.98% of overall citations. Results indicate that literature published by western countries was greatly cited. USA, United Kingdom and Netherlands top the list of country wise citations with 33.69%, 27.14% and 18.83% respectively. It is observed that majority of cited journal sources were by three authors (19.97%) followed by two authors (18.90%) and four authors (16.31%). Journal articles authored by single authors were cited to an extent of 9.29% and a small percent of journal articles were authored by eight authors (2.88%). Further, Rank list of publishers shows that journals (32.35% of overall journal citation) published by Elsevier were profoundly preferred by the chemistry research publications.

Keywords: Citation analysis, Bibliometric, Journal Citations and Core Journals.

Introduction

Scholars transfer knowledge to audiences through scholarly communications in formal records such as books, journals, proceedings, etc. Scholarly communications are

written based on results of earlier studies and generally scholars refer and cite similar works in their researches to substantiate their outcomes. Hence, to ensure the adequate information is available to the scientific community for conducting researches, libraries should evaluate use of its collection through bibliometric techniques. This practice will certainly help the libraries to understand the information needs of its patrons and to plan on procuring requisite information sources time to time. Among the existing bibliometric techniques citation analysis has been one of the most widely adopted methodologies for the identification of core resources referenced in scholarly communications.

Research in science and technology in general and chemistry in particular has been extending both in qualitative and quantitative terms across the globe and the contribution of Indian scientists has been quite significant. India has a long history of chemical investigations and chemistry is the most "popular" discipline followed by mathematics and physics (Karki and Garg, 1999). Considering this phenomenal advancement in the researches of chemistry investigators of this study decided to discover the core documents consulted by chemists in the research publications of University of Mysore and Karnatak University through citation analysis.

Literature review

According to Obokoh (1986) citation or reference analysis is a more prevalent accepted method of assessing the characteristics of literature used by scholars in the sciences and, to a large extent, in the social sciences. The purpose for this investigation may range from such varied reasons as providing a list of further reading, tracing original works or studying the frequency of journals for acquisition. Similarly Abba, Boliya & Aliyu (2019) stated that providing required information to the library patrons and observing the resources used are some of primary tasks of librarians to frame acquisition policy. Chikate & Patil (2008) indicated that citation analysis is a way to understand type of documents used by the researchers and faculty members in writing their theses, research articles, project reports etc. Thus, it can be adopted by academic libraries to investigate the core references cited by the scholars in any disciplines (Bornmann & Daniel, 2008).

Studies on most cited information sources

Citation analysis is a proven technique adopted by various libraries to develop its collection by identifying the top most sources used by its patrons in their scholarly documents. In this direction, several studies were conducted to identify the top cited sources.

Gooden (2001) analyzed dissertations accepted in the Department of Chemistry at The Ohio State University during 1996-2000 as a way to determine material use. A total of 3,704 citations generated from 30 dissertations were studied. Study revealed that 85.8% of the citations were journal articles and 8.4% of the citations were monographs. He stated that results of his study may be used to assist Ohio State University and other universities in chemistry collection development. Similar result was observed in the study conducted by Zhang (2013) who compared uses of research materials in chemistry versus chemical engineering dissertations completed at Mississippi State University, 2002–2011. Unsurprisingly, journal articles and books were the dominant format of cited sources, and conference proceedings and web resources accounted for much of the remainder. Researchers from Spain by name Vallmitjana & Sabate (2008) carried out a study on the citations within the chemistry field Ph.D. dissertations to ascertain what types of documents are the most frequently used in the research process, the most frequently consulted journals and obsolescence rate of the journals. The study covered 46 doctoral theses presented at the Institut Quimic de Sarria (IQS) from 1995 to 2003. The results obtained from the 4,203 citations revealed that the most frequently used documents were scientific papers, which accounted for 79 percent of the total.

Studies on authorship pattern

The number of authors contributing to scholarly publications in terms of authorship pattern is an interesting part of any bibliometric study. A count of number of authors contributing to articles offers some indication to the degree of collaboration between authors. Cronin, Shaw & Barre (2003) commented, authorship as “undisputed coin of the real in academia” and “absolutely central to the operation of the academic reward system”. However, the concept of authorship was evolved over the course of the 20th century, with a steady increase in collaboration. This trend was anticipated by Price (1963), who stated, “by 1980 the single-author paper will be extinct” and scholarly publications will “move steadily toward infinity of authors per paper”.

A large number of studies have been conducted to analyze and interpret the trends in collaborative authorship in different disciplines. Authorship trend in the field of agriculture science was seen in many studies (Kumbar, Harinarayana & Tejaswini, 2004; Krishna & Kumar, 2004 & Farhat, 2002). Bandyopadhyay (2001) has studied the authorship collaboration in physics, philosophy and political science. The author also analyzed the authorship pattern of different disciplines such as mathematics, physics, mechanical engineering, philosophy and political science (2001). Vimala & Reddy (1996) investigated

the authorship trend in zoology. Collaborative research in psychology in India was studied by Sangam (2000). Vijay (2005) studied the Indian food science and technology literature and Rana and Agarwal (1994) analyzed the Indian wild life and fisheries literature. Visakhi and Srivastava (2002) studied the collaborative authorship of statistical science. Other similar studies include Tiew, 2006; Ivanisevic & Sapunar, 2006; Kannappanavar & Vijayakumar 2001 and Raina, Gupta and Khandari (1995). Some of the relevant results of similar studies on authorship pattern in different subjects are mentioned here. Karisidappa, Maheswarappa & Shirol (1990) studied "Authorship pattern and collaborative research in psychology" based on the data collected from Psychological Abstracts' for the year 1988, where 39.43% of the papers accounted for single-authorship and the degree of collaboration in psychology was 0.80.

Objectives of the study

1. To identify the most cited sources of information consulted by the researchers in chemistry.
2. To observe the nature of authorship pattern in the literature of Chemistry
3. To identify the top 25 authors whose publications in the chemistry literature were most often cited.
4. To study the year wise authorship trends in chemistry
5. To identify the degree of Authorship Collaboration in citations of chemistry
6. To study the country wise citations
7. To determine the most frequently cited journals in chemistry researches.

Methodology

The main data source for this study is the chemistry research publications of University of Mysore and Kartnak University covered by Web of Science for the period 2009-2018. This study opted purposive sampling and selected only the chemistry research publications which includes 1365 research publications published by various publishers such as Elsevier, Springer, Wiley, American Chemical Society and others. Each research papers considered by this study were downloaded from the respective publishers' websites and analyzed to record the details of the author, title, country and publisher of journals publication. The data collection was done manually and analysis was done with the help of MS excel.

Results and Discussions

Source type wise distribution of citations in chemistry

Table 1 Source type wise distribution of citations in chemistry

Sl. No.	Source type	Citations	%
1	Journals	38875	89.98
2	Books	2842	6.58
3	Software	470	1.09
4	Conference proceedings and meetings	273	0.63
5	Manuals	171	0.40
6	Abstracts	153	0.35
7	Patents	152	0.35
8	Standards	90	0.21
9	Websites	78	0.18
10	Handbooks	35	0.08
11	Reports	31	0.07
12	Theses	17	0.04
13	Database	9	0.02
14	Encyclopedias	4	0.01
15	Dictionaries	2	0.005
16	Dissertations	2	0.005
Total		43204	100

It is observed from the analysis (table 1) that 1355 research publications of chemistry generated a total of 43204 citations and they have been categorized in to 16 bibliographic forms, of which journal articles were cited most frequently (89.88%), followed by books (6.58%), software (1.9%) conference proceedings (.063%) and manuals (0.40%). This findings corroborates the findings of other studies who reported that journals were cited most with 91.00% (Kimball et al., 2013), 85.8% (Gooden, 2001) 85.01% (Kaczor, 2014), 79.00% (Vallmitjana & Sabate, 2008) and (Mubeen, 1996) of overall citations. However, this finding is inconsistent to the study by Doraswamy and Pulla Reddy (2001) who revealed that books were the most preferred source of information and contributed the highest number of citations. Theses and dissertations attained 0.04 % and 0.005 % of total citations respectively; though they were scientific by nature, use of such literature seems to be very less in this study. Further, it is interesting to note that journals, books, software and conferences

proceedings together comprised majority of citations i.e., (98.28%) of total citations. The bibliographic form referred to as 'software' includes the applications which are often used to create crystal reports and likewise.

Country wise citations

Table 2 Country wise distribution of cited sources

Sl. No.	Country	Citations					
		Journals	Books	Other sources	Total	%	Rank
1.	USA	12353	1576	627	14556	33.69	1
2.	United Kingdom	11291	390	44	11725	27.14	2
3.	Netherlands	8035	82	18	8135	18.83	3
4.	India	1520	181	166	1867	4.32	4
5.	Germany	1518	127	68	1713	3.96	5
6.	Switzerland	541	6	2	549	1.27	6
7.	Japan	499	13	4	516	1.19	7
8.	Italy	400	6	2	408	0.94	8
9.	UAE	359	16	0	375	0.87	9
10.	China	149	53	0	202	0.47	10
11.	Canada	183	1	1	185	0.43	11
12.	Egypt	179	2	0	181	0.42	12
13.	Russia	145	1	1	147	0.34	13
14.	Serbia	143	3	0	146	0.34	14
15.	South Korea	130	0	0	130	0.30	15
16.	Poland	105	0	0	105	0.24	16
17.	Brazil	85	0	1	86	0.20	17
18.	Saudi Arabia	74	0	0	74	0.17	18
19.	France	59	8	5	72	0.17	19
20.	Turkey	58	0	0	58	0.13	20
21.	Bulgaria	56	0	0	56	0.13	21
22.	Austria	42	0	5	47	0.11	22
23.	Singapore	29	17	0	46	0.11	23
24.	Spain	43	2	0	45	0.10	24
25.	Croatia	45	0	0	45	0.10	24
26.	Chile	43	0	0	43	0.10	25

27.	Hungary	39	0	0	39	0.09	26
28.	Romania	38	0	0	38	0.09	27
29.	Australia	22	2	12	36	0.08	28
30.	Czech Republic	34	0	0	34	0.08	29
31.	Pakistan	30	1	0	31	0.07	30
32.	Taiwan	30	0	0	30	0.07	31
33.	Greece	29	0	0	29	0.07	32
34.	Thailand	28	0	0	28	0.06	33
35.	New Zealand	21	0	1	22	0.05	34
36.	Iran	22	0	0	22	0.05	34
37.	Ethiopia	19	0	0	19	0.04	35
38.	Nigeria	16	0	0	16	0.04	36
39.	Ukraine	14	0	0	14	0.03	37
40.	Malaysia	14	0	0	14	0.03	37
41.	Mexico	12	0	0	12	0.03	38
42.	Portugal	11	0	0	11	0.03	39
43.	Sweden	10	1	0	11	0.03	39
44.	Slovenia	11	0	0	11	0.03	39
45.	Argentina	10	0	0	10	0.02	40
46.	South Africa	9	0	0	9	0.02	41
47.	Belgium	7	1	0	8	0.02	42
48.	Latvia	7	0	0	7	0.02	43
49.	Finland	0	5	0	5	0.01	44
50.	Bahrain	4	0	0	4	0.01	45
51.	Hong Kong	4	0	0	4	0.01	45
52.	Kosovo	4	0	0	4	0.01	45
53.	Berlin	3	1	0	4	0.01	45
54.	Jamaica	4	0	0	4	0.01	45
55.	Morocco	3	0	0	3	0.01	46
56.	Slovakia	3	0	0	3	0.01	46
57.	Bangladesh	1	0	2	3	0.01	46
58.	Holland	2	0	0	2	0.00	47

59.	Jordan	2	0	0	2	0.00	47
60.	Lithonia	2	0	0	2	0.00	47
61.	Norway	0	0	2	2	0.00	47
62.	Kenya	1	0	0	1	0.00	48
63.	Iraq	1	0	0	1	0.00	48
64.	Uganda	1	0	0	1	0.00	48
65.	Not available	323	347	526	1196	2.77	
Total		38875	2842	1487	43204	100.00	

It is observed from the table 2 that researchers in chemistry have cited journal literature published from 64 countries. Of all the countries, USA dominates with 14556 cited sources accounting for 33.69%, United Kingdom and Netherlands follow next with a list of 11725 (27.17%) and 8135 (18.83%) citations respectively. India occupies fourth rank with 1867(4.32 %) citations. It is interesting to note that only three countries namely USA, United Kingdom, Netherlands together form 79.66% of total citations. Therefore, it is inferred that scholars of chemistry majorly citing the literature published from western countries in their research works.

Authorship pattern in Journal citations of chemistry

Table 3 Authorship pattern in journals citations of chemistry

Authorship pattern	Citations	%	Cumulative citations	Cumulative %	No. of Authors
Single	3613	9.29	3613	9.29	3613
Two	7348	18.90	10961	28.20	14696
Three	7763	19.97	18724	48.16	23289
Four	6341	16.31	25065	64.48	25364
Five	4813	12.38	29878	76.86	24065
Six	3174	8.16	33052	85.02	19044
Seven	1879	4.83	34931	89.85	13153
Eight	1121	2.88	36052	92.74	8968
Nine	756	1.94	36808	94.68	6804
Ten	512	1.32	37320	96.00	5120
Above ten	1312	3.37	38632	99.37	20782

Not available	243	0.63	38875	100.00	0
Total	38875	9.29	3613	9.29	164898
Average authorship					4.24

Authorship pattern is also one of the main objectives of the study; it was analyzed to determine the percentage of single and multiple authors in the chemistry research publications of University of Mysore and Karnatak University. The authorship patterns were categorized into ten groups; single author, two author, three author, four author, five author and so on and more than ten author contributions. Distribution of used literature according to number of authors in the citations of journals was projected in the tables Table 3.

By analyzing the data presented in the table 3 it is observed that majority of cited journal sources were by three authors (19.97%) followed by two authors (18.90%) and four authors (16.31%). Journal articles authored by single authors were cited to an extent of 9.29% and a small percent of journal articles were authored by eight authors (2.88%), nine authors (1.94%) and ten authors (1.32%). Articles which include more than ten authors account for (3.37%). Further, 38632 journal articles were found to have collaborated by 164898 authors with a 4.24 average authorship.

Year wise authorship trends in chemistry

Citations are grouped according to year of publication of cited documents for studying the changes in authorship trends with progressive time. For this purpose, the data was divided into 12 groups by range of year of publication with a span of 10 years. The distributions of these groups of citations according to number are presented in table 4 for journals.

Table 4 Year wise distribution of authorship pattern in journal citations of chemistry

Year	Single	Two	Three	Four	Five	>five	Not Available	Total	%
Oldest to 1910	44	10	1	1	1	4	2	63	0.16
1911-1920	6	6	0	1	0	0	0	13	0.03
1921-1930	8	23	0	0	1	0	0	32	0.08
1931-1940	28	35	2	1	1	1	0	68	0.17
1941-1950	45	69	17	19	3	2	0	155	0.40
1951-1960	136	132	103	41	4	11	1	428	1.10
1961-1970	199	403	111	60	15	21	2	811	2.09
1971-1980	261	581	343	112	36	58	10	1401	3.60

1981-1990	382	788	755	395	185	345	23	2873	7.39
1991-2000	778	1463	1459	1188	602	1175	38	6703	17.24
2001-2010	1442	2930	3653	3219	2720	4134	119	18217	46.86
2011-2018	283	904	1318	1304	1245	3003	48	8105	20.85
Not available	1	4	1	0	0	0	0	6	0.02
Total	3613	7348	7763	6341	4813	8754	243	38875	100.00

It is clear from the table 4 that the tendency of multi authorship or collaboration research has been consistently grown in two authored, three authored and more than three authored journal articles. It is also observed that chemistry scholars have used the three authored papers to a greater extent followed by two authors. It is also interesting to note that use of single authored articles published during 2001-2010 was more than the articles published during other periods. Further, it is evident from the table that multiple authorship articles is higher than the single authored articles over the years except for the period from oldest to 1910 where single authored contributions (44) is more than multi authored articles (19).

Degree of Authorship Collaboration in citations of chemistry

The degree of collaboration is the ratio of multi authored papers published to the total number of papers published in a discipline during certain period of time. The formula given by Subramanyam is useful for determining the degree of collaboration in quantitative terms. The study followed the same formula which is mathematically put as:

$$C = \frac{Nm}{Nm + Ns}$$

Where, C= Degree of collaboration in a discipline.

Nm = number of multi-authored papers

Ns = number of single- authored papers

Using the formula, the degree of collaboration in the field of chemistry has been determined and presented in Table 5. Those citations which didn't have authorship patterns have been excluded from the calculation of degree of authorship.

Table 5 Degree of authorship collaboration in citations of chemistry

Authorship	**Single author**	**%**	**Multi authors**	**%**	**Total**	**%**	**Degree of collaboration**
Journals	3613	9.35	35019	90.65	38632	91.58	0.91
Books	1443	55.18	1172	44.82	2615	6.20	0.45
Others	378	40.38	558	59.62	936	2.22	0.60
Total	5435	12.88	36749	87.12	42184	100.00	0.87

It is reported during the period of study that the share of multiple authored literature (87.12%) in chemistry as a broad subject is much higher than the single authored documents (12.88%). But, there are some differences in the trends of multiple authorship characteristics in journal and non-journal literature. 90.65 % of the journal citations are multiple authored whereas only 44.82% of the books and 59.62% of other citations are multiple authored which may be clearly seen from the table 5.19.

In the present case C is 0.87 and the calculation of the same is presented as below

$$C = \frac{36749}{36749+5435}$$

In the above table 5 the distribution of degree of collaboration in chemistry is clearly represented stating journal articles rank first with 0.91, next to the books with 0.45 followed by other forms of sources with 0.60 degree of authorship. The degree of collaboration in in the field of chemistry is 0.87. Hence, the degree of collaboration of journal literature in chemistry is much higher which clearly indicate its dominance upon individual researches.

Prolific authors in chemistry

Table 6 top 25 prolific authors

Sl. No.	Name	Citations	H index	Affiliation	country
1	Rangappa K. S.	912	37	University of Mysore	India
2	Nandibewoor S. T.	589	33	Karnatak University	India
3	Yathirajan H. S.	526	21	University of Mysore	India
4	Sheldrick G. M.	451	47	University of Gottingen	Germany
5	Narayana B.	465	24	Mangalore University	India
6	Basappa	335	24	University of Mysore	India
7	Patil S. A.	229	11	University of Tennessee	USA
8	Liu Y.	221	44	Chinese academy of	China

				science	
9	Aminabhavi T. M.	203	74	SET College of Pharmacy	India
10	Sarojini B. K.	203	22	Mangalore University	India
11	Kulkarni M. V.	202	35	Savitribai Phule Pune University	India
12	Sethi G.	201	35	Curtin University	Australia
13	Jasinski J. P.	191	28	University of Mysore	India
14	Mohan C. D.	191	18	University of Mysore	India
15	Raghavan S. C.	171	30	Indian Institue of Science	India
16	Bender A.	170	86	University of South Florida	India
17	Revankar V. K.	170	20	Karnatak University	India
18	Taylor R.	170	47	University of York	England
19	Chen X.	168	44	University of California	USA
20	Li Y.	166	93	University of California	USA
21	Zhang Y.	164	15	Yangtze university	China
22	Wang Y.	157	13	Yangtze university	China
23	Spek A. L.	155	83	Utrecht University	Netherlands
24	Fun H. K.	150	34	University of Science	Malaysia
25	Butcher R. J.	145	52	Howard University	USA

.

Table 6 shows that Rangappa K.S. is the most productive author with 912 citations followed by Nandibewoor S. T. with 589 citations and Yathirajan H. S. with 526 citations. Out of 25 authors majority of 13 are from India and 4 from USA, remaining 8 authors are from countries like China, Germany, Netherlands, Malaysia, Australia and England. Therefore, it is concluded that majority of journal literature cited in chemistry were authored by Indian scholars. Further, it is also witnessed from the list that six authors are from University of Mysore and four authors are from Karnatak University. It indicates researchers in chemistry largely cite the journal literature written by authors of its own Universities.

Ranked list of core publishers

Table 7 Publishers Wise distribution of Journal Citations

Sl. No.	Publishers	Citations	%	Rank
1	Elsevier	12576	32.35	1
2	American Chemical Society	4962	12.76	2
3	Wiley	4524	11.64	3
4	Royal Society of Chemistry	1710	4.40	4
5	International Union of Crystallography	954	2.45	5
6	Springer	923	2.37	6
7	Scientific Publishers	917	2.36	7
8	Kluwer Academic Publishers	900	2.32	8
9	Nature	668	1.72	9
10	Taylor & Francis	644	1.66	10
11	Marcel Dekker	489	1.26	11
12	Georg Thieme Verlag	357	0.92	12
13	Bentham Science Publishers	308	0.79	13
14	Oxford University Press	276	0.71	14
15	Royal Chemical Society	260	0.67	15
16	American Society for Biochemistry and Molecular Biology Inc.	223	0.57	16
17	American Institute of Physics	222	0.57	17
18	American Physical Society	213	0.55	18
19	Gordon and Breach Science Publishers	192	0.49	19
20	American Association for Cancer Research	180	0.46	20
21	Walter de Gruyter GmbH	177	0.46	21
22	Multidisciplinary Digital Publishing Institute	176	0.45	22
23	Lippincott Williams & Wilkins Ltd.	169	0.43	23
24	American Association for the Advancement of Science	164	0.42	24
25	Maik Nauka Publishing	160	0.41	25
26	Others	6531	16.80	
Total		38875	100.00	

Scientific information are published by thousands of publishers across the world through their own platforms where academics and information professionals get scholarly publications for research activities. Due to excessive information production and libraries 'low budget of libraries will subscribe journals based on reputed publishers. Keeping this in mind investigators of this study listed the top 25 core publishers to assist libraries of both University of Mysore and Karnatak University in selecting publishers for subscriptions.

Table 7 reveals that maximum cited journal literature in chemistry was published by Elsevier with 12576 citations (32.35%) followed by American chemical society with 4962 (12.76%) citations, Wiley with 4524 (11.64%) and Royal Society of Chemistry with 1710 citations (4.40). All these four publishers together cover 61.15% of total citations and remaining publishers in the list carry less than thousand citations.

Ranked list of cited journals

The ranking list of journals is a practical tool that helps in selecting journals of maximum utility in relation to their coverage of new and important literature in a particular subject area. Ranked list of journals in this study was prepared based on the citations rendered in publications covered by this study. Study also attempted to provide impact factor and SJR score of top 25 core journals in chemistry.

Table 8 ranked list of journals in chemistry

Sl. No.	**Journal**	**Rank**	**Citations**	**%**	**Publisher**	**Country**	**SJR**	**IF**	**Access Type**
1	European Journal of Medicinal Chemistry	1	1041	2.68	Elsevier	France	1.14	5.57	Paid
2	Acta Crystallographica Section E	2	950	2.44	International Union of Crystallography	UK	-	-	Open
3	Journal of Medicinal Chemistry	3	877	2.26	Royal Society of Chemistry	UK	-	7.62	Paid
4	Journal of the American Chemical Society	4	796	2.05	American Chemical Society	USA	6.98	14.69	Paid
5	Bioorganic and Medicinal	5	763	1.96	Elsevier	UK	0.74	2.79	Paid

	Chemistry								
6	Tetrahedron Letters	6	709	1.82	Elsevier	UK	0.58	2.37	Paid
7	Journal of Organic Chemistry	7	596	1.53	American Chemical Society	USA	1.35	4.8	Paid
8	Bioorganic and Medicinal Chemistry	8	548	1.41	Elsevier	UK	0.74	2.79	Paid
9	Acta Crystallographica Section A	9	541	1.39	International Union of Crystallography	UK	0.72	1.96	Open
10	Spectrochim Acta A	10	486	1.25	Elsevier	Netherlands	0.55	2.93	Paid
11	Tetrahedron	11	404	1.04	Elsevier	UK	0.58	2.64	Paid
12	Angewandte Chemie - International	12	373	0.96	Wiley	UK	5.44	12.25	Paid
13	Journal of Pharmaceutical and Biomedical Analysis	13	371	0.95	Elsevier	Netherlands	0.8	3.2	Paid
14	Inorganic Chemistry	14	352	0.91	American Chemical Society	USA	1.35	4.85	Paid
15	Transition Metal Chemistry	15	349	0.90	Springer	Netherlands	0.26	0.44	Paid
16	Chemical Reviews	16	343	0.88	American Chemical Society	USA	20.85	54.31	Paid
17	Journal of Applied Crystallography	17	325	0.84	Elsevier	Netherlands	1.14	0.48	Paid
18	Indian Journal of Chemistry A	18	315	0.81	Scientific Publishers of India	India	0.17	0.48	Open
19	Journal of Molecular Structure	19	304	0.78	Elsevier	Netherlands	0.45	2.11	Paid
20	Organic Letters	20	287	0.74	American Chemical Society	USA	2.03	6.55	Paid

21	Talanta	21	278	0.72	Elsevier	Netherlands	1.18	4.91	Paid
22	Journal of Membrane Science	22	274	0.70	Elsevier	Netherlands	1.9	7.01	Paid
23	Polyhedron	23	249	0.64	Elsevier	UK	0.45	2.06	Paid
24	Nature	24	223	0.57	Nature Publishing Group	UK	14.05	43.07	Paid
25	Coordination Chemistry Reviews	25	220	0.57	T&F	UK	0.54	0.21	Paid
26	others		26901	69.20					
Total			38875	100.00					

European Journal of Medicinal Chemistry published by Elsevier from France ranks 1st with the highest concentration of citations in chemistry. It is having 1041 citations forming 2.68 % of the total journal citations. It is followed by Acta Crystallographica Section E published from UK by International union of Crystallography with 950 citations (2.44 %). Journal of Medicinal Chemistry published by Royal Society of Chemistry from UK with 877 (2.26%) citations occupies third rank. It is worthwhile to mention that the journal Acta Crystallographica Section E which is ranked 2nd in the list is an open access journals. Further, it is observed that majority of journals in this list are paid journals.

Conclusion

Citation analysis has been very useful in determining various scientific journals for selection by libraries and in understanding growth and development of a research field. Libraries have the responsibility of selecting and procuring the best literature in the form of books and journals in a given field of research. As cost of books and subscription amount of journals are increasing at a rapid pace, it is increasingly important for libraries to carefully select the resources which are necessary for its patrons. Hence, the present study was carried out on cited references of research publications in chemistry of University of Mysore and Karnatak University to help librarians to select the core journals in the area of chemistry.

References

Bandyopadhyay, A. K. (2001). Authorship pattern in different disciplines. *Annals of Library and Information Studies, 48*(4), 139-147

Boda, T. A. (2019). Citation Analysis of Doctoral Theses In Library And Information Science Submitted To University Of Maiduguri, Nigeria. *Library Philosophy and Practice*, 1-26.

Bornmann, L., & Daniel, H. (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation*, *64*(1), 45–80.

Borthakur, P. (2015). Citation analysis of theses and dissertations in chemistry submitted to the LNB Library, Dibrugarh University, 2009-13. *International Journal of Research in Library Science*, *1*(2), 33-41.

Chikate, R. V., & Patil, S. K. (2008). Citation analysis of theses in library and information science submitted to University of Pune: A pilot study. *Library Philosophy and Practice*, 31-55.

Cronin, B., Shaw, D., & La Barre, K. (2003). A cast of thousands: Co-authorship and sub-authorship collaboration in the 20th century as manifested in the scholarly journal literature of psychology and philosophy. *Journal of the American Society for information Science and Technology, 54*(9), 855-871

Farhat, H. (2002). Authorship patterns in agriculture science in Egypt. *Scientometrics*, *55*(2), 157-170.

Gooden, A.M. (2001), "Citation analysis of chemistry doctoral dissertations: an Ohio State University case study", Issues in Science and Technology Librarianship, 32, 1-16.
Karki, M. M. S., & Garg, K. C. (1999). Scientometrics of Indian organic chemistry research. *Scientometrics*, *45*(1), 107-116.

Ivanisevic, R., & Sapunar, D. (2006). Multiple authorship in a small medical journal: A case study of the Croatian Medical Journal. *Journal of the American Society for Information Science and Technology*, *57*(8), 1073-1078.

Kannappanavar, B. U., & Vijayakumar, M. (2001). Authorship trend and solo v/s team research in International Monetary Fund literature: A bibliometric study. *Annals of Library and Information Studies, 48* (3), 117-120

Kimball, R., Stephens, J., Hubbard, D., & Pickett, C. (2013). A citation analysis of atmospheric science publications by faculty at Texas A&M University. *College & Research Libraries*, *74*(4), 356-367.

Krishna, K. M., & Kumar, S. (2004). Authorship trends in agriculture research: a bibliometric analysis. *SRELS Journal of Information management*, *41*(2), 229-234.

Kumbar, M., Harinarayana, N. S., & Tejaswini, T. (2005). Authorship trend and collaborative research in agricultural sciences. *IASLIC Bulletin*, *50*(4), 241.

Mubeen, M. A. (1996). Citation analysis of doctoral dissertations in chemistry. Annals of Library Scicne and Documentation, *43*(2), 48-58.

Obokoh, N. P. (1986). Characteristics of literature used by contributors to the Nigerian Geographical Journal. *Library Waves*, 1, 93-104.

Price, Derek J. deSolla. (1963). Little science, Big science. New York: Columbia Press.

Rana, M. S. & Agarwal S. (1994). Authorship trends in Indian wildlife and fisheries literature: Tiew, W. S. (2006). Authorship characteristic in Sekitar Perpustakaan 1994-2003: a bibliometric study. *Malaysian Journal of Library & Information Science*, *11*(1), 49-59.

Sangam, S, L, Collaborative research in Psychology in India: a scientometric study, In: Collaboration in science and technology. Proceedings of the 2nd Berkin workshop on Scientometrics and Informetrics, Sept 1-3, 2000, Berlin, ed. by Frank Havemann, Roland Wahgner-Dobler and Hildrum Kretschmer, p.177-183.

Vallmitjana, N., & Sabate, L. G. (2008). Citation analysis of Ph. D. dissertation references as a tool for collection management in an academic chemistry library. *College & Research Libraries*, *69*(1), 72-82.

Vimala, V., & Reddy, V. P. (2017). Authorship pattern and collaborative research in the field of zoology. *Malaysian Journal of Library & Information Science*, *1*(2), 43-50.

Vijay, K. R. (2005). Bibliometric study of research publication trend among Indian food scientists and technologists, *Annals of Library and Information Studies, 52*(3), 77-81.

Zhang, L. (2013). A Comparison of the Citation Patterns of Doctoral Students in Chemistry versus Chemical Engineering at Mississippi State University, 2002–2011. *Science & Technology Libraries*, *32*(3), 299–313.